

Dry SHIPS Recordings of the Chi-Chi Earthquake, Seattle, Washington

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Dry SHIPS was a seismic refraction study of the Seattle basin, Washington State, involving 29 chemical explosions recorded by 1008 seismographs, conducted in September 1999. The E-W trending Dry SHIPS line ran eastward from the Olympic Peninsula, through the Seattle basin, to the foothills of the Cascade mountains. Twenty-eight REFTEKs (DAS Model 07G; 24-bit) deployed along the Dry SHIPS line at 4 km intervals were programmed to record data continuously from 3-component sensors (Table 1). These 28 stations recorded the main shock and several aftershocks of the $M_w = 7.6$ Chi-Chi earthquake (Shin et al., 2000; Brocher et al., 2000a).

The recordings were made with REFTEKs described by PASSCAL (1991). The three-component Mark Products (copyright) L-28 4.5-Hz geophones were oriented such that the longitudinal (N-S) component was directed to magnetic north. [The eastward declination of magnetic north relative to true north in Seattle is about 20 degrees.] The REFTEKs were equipped with Global Positioning System (GPS) receivers to synchronize the internal timing on the individual REFTEKs to satellite timing. The REFTEKs recorded continuously at a sample rate of 250 samples/sec (4 msec sample interval) but have been resampled here to a 20 msec sample rate after the application of an anti-alias filter. The original records are available from the IRIS Data Management Center in Seattle. On this CD the stations are identified by their Data Acquisition System (DAS) number (Table 1).

The azimuth of propagation to the Dry SHIPS array was about 37 degrees for the Chi-Chi signals. The stations were located at distances between 88.5 and 89.5 degrees from the Chi Chi epicenter. The Dry SHIPS recordings of the Chi-Chi mainshock provide useful signals from 50 Hz down to 10 second periods, although at higher frequencies the Chi-Chi signals are not discernible due to the ambient noise. A further caveat is that these data contain abrupt offsets in amplitude caused by voltage steps associated with writing data to disk. At high frequencies these VOLTAGE steps are lost in the noise and pose no problems, but at longer periods (e.g., greater than 4 seconds) these steps may cause serious problems on all three channels.

The recordings document a significant (factor between 5 and 10) amplification of compressional- and shear-wave energy in the Seattle basin at periods between 1 and 2 seconds relative to BEDROCK sites east and west of the basin

(Brocher et al., 2000b). Signal durations in the Seattle basin were also substantially increased relative to BEDROCK sites in the Olympic peninsula and Cascade foothills, approaching 100 seconds in the vicinity of Seattle.

The archived data are given on the attached CD-ROM, under the directory of \BrocherTM: (1) a readme.txt file (this Note); (2) headers.txt -- the header information from the original records; (3) a compressed file containing the digital waveform data in SAC format; and (4) a sub-directory \PDFfiles, containing 28 PDF files of waveform plots by station. The digital waveform data are given in physical units of VOLTS, and were converted from the recorded DIGITAL COUNTS by multiplying the scale factor of 1.89551E-06. Note that signals generated by the Chi-Chi earthquake can be revealed by applying a low-pass filter to the data.

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Table 1. REFTEK Locations and Elevations (WGS 1984 Datum).

DAS	Latitude	Longitude	Elev. (m)
7268	47.664950	-122.558336	81
7269	47.663331	-122.589228	29
7270	47.751751	-122.562810	27
7278	47.649907	-121.728250	413
7280	47.669515	-122.051992	155
7283	47.730413	-123.133018	411
7284	47.743521	-122.115097	168
7289	47.673382	-121.991437	201
7294	47.679133	-122.678547	59

7295	47.660831	-121.616803	473
7298	47.676645	-122.637708	73
7359	47.662819	-122.096633	29
7443	47.735803	-123.082747	232
7446	47.690419	-122.741529	64
7597	47.657022	-121.833829	206
7599	47.666493	-122.149567	103
7601	47.661199	-122.204631	23
7605	47.581374	-122.035659	138
7606*	47.607015	-122.283886	18
7609	47.690417	-122.805850	24
7610	47.672049	-122.300207	49
7612	47.661531	-121.892645	96
7613	47.735042	-123.022541	124
7614	47.735483	-122.028715	173
7617	47.548523	-122.115515	346
7618	47.671045	-122.355792	104
7622	47.672202	-121.940457	55
7626	47.671987	-122.270937	39

*This station was formerly assigned